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ABSTRACT

BACKGROUND: The objective was to identify predictors of societal costs covering formal and informal care utilization by older home care clients in 11 European countries.

METHODS: Societal costs of 1907 older clients receiving home care for 12 months from the Aged in Home care (AdHoc) study were estimated using the InterRAI Minimum Data Set for Home Care's (MDS-HC) resource use items. Predictors (medical, functional, and psychosocial domains) of societal costs were identified by performing univariate and multivariate generalized linear model analyses.

RESULTS: Mean societal costs per participant were €36 442, ranging from €14 865 in Denmark to €78 836 in the United Kingdom. In the final multivariate model, country, being married, activities of daily living (ADL) dependency, cognitive impairment, limitations of going out, oral conditions, number of medications, arthritis, and cerebro vascular accident (CVA) were significantly associated with societal costs.

CONCLUSIONS: Of the predictors, ADL dependency and limitations of going out may be modifiable. Developing interventions targeted at improving these conditions may create opportunities to curtail societal costs.

KEYWORDS: Predictors of costs, societal costs, Minimum Data Set for Home Care, home care, older adults

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Introduction

The European population is aging rapidly.[1] Aging is associated with increased prevalence of disease and disability. In combination with the increasing numbers of older adults, the share of care-dependent older adults that need long-term care has grown exponentially over the past decades.[2] This has led to a significant increase in the costs of long-term care, especially in North Western European countries.[3] To meet the care needs of older persons in the (near) future, European governments are looking for financially sustainable solutions to organize care.

One of the solutions the governments have come up with to reduce the high expenses on care for the aging European population is the promotion of home care, as this is generally a less costly option than institutional care (nursing home or inpatient admission).[4,5] The intensification of home care is expected to postpone or prevent institutionalization by maintaining individuals at home, which is highly preferred by older adults.[6] Over the past two decades, home care has been one of the fastest growing health care sectors, and the demand for home care is still growing.[7,8] As future demands will presumably outgrow

the financial capacity of home care under current health care policies, it is expected that home care resources will become increasingly scarce.[9] To allocate available resources efficiently, it is important to identify client characteristics associated with costs of formal and informal care utilization (further referred to as societal costs of care utilization). This will result in understanding of factors that should be addressed to keep overall costs of home care users in hand.

Information on predictors of costs in a general European population of care-dependent community-dwelling older adults is limited. Most European studies that have investigated predictors of (societal) costs of care utilization of older adults living in the community, focused on specific disease groups, such as people with dementia or diabetes.[10–16] To add to this knowledge, the objective of this study was to identify socio-demographic, clinical, and lifestyle predictors of societal costs of resource utilization by older home care clients across 11 European countries.

Methods

Study design and data collection

Data were derived from the longitudinal cohort study "Aged in Home care" (AdHoc). The AdHoc study was conducted in 2001 and 2002 and aimed to compare characteristics of older home care recipients in Europe. The methodology of the AdHoc study is described in detail elsewhere.[7] In short, a total of 4007 older adults aged 65+, who received home help or home nursing care services, were enrolled from selected urban areas in 11 European countries comprising Prague, Czech Republic; Copenhagen, Denmark; Helsinki, Finland; Amiens, France; Nurnberg and Bayreuth, Germany; Reykjavik, Iceland; Monza, Italy; Amsterdam, the Netherlands; Oslo, Norway; Stockholm, Sweden; and Maidstone/Ashford, United Kingdom. Detailed information was collected using the interRAI Minimum Data Set for Home Care (MDS-HC) version 2.0.[17,18] This validated comprehensive geriatric assessment instrument includes over 300 items on socio-demographic, physical, and cognitive characteristics of patients as well as information on medical diagnoses and service utilization.[18,19] Minimum Data Set for Home Care assessments were performed by trained (research)nurses at baseline with reassessments at 6 and 12 months. This study uses baseline and 12 month follow-up assessment data. All participants gave informed consent, and ethical approval was obtained in all participating countries according to local regulations.

Study sample

For this study, adults aged 65 years or older, receiving home help or home nursing care for 1 year, included in the AdHoc study were eligible. Home help was defined as providing professional assistance with activities of daily living (ADL) such as washing, getting dressed, and eating, and home nursing care was defined as activities of nurses that are of a technical, medical, or rehabilitative nature.

Consecutive clients were included in the AdHoc study and could be new clients but also clients already receiving home care. Only participants with available MDS-records at baseline and at 12 months were included. Discharged participants and participants with missing MDS-records at 12 months, were excluded.

Outcome measure

The outcome measure was societal costs of older adults that received home care during the course of 1 year. Total societal costs included costs of formal and informal resource utilization as assessed by the MDS-HC. Costs of formal and informal care utilization were calculated using standard costs according to the Dutch guidelines for costing studies using prices of the year 2010.[20] The advantage of using one set of standard costs is that it ignores welfare differences between countries that can prohibit an equal comparison.

Included care services and treatments. Formal care costs included the categories primary care, secondary care, home care, and social care costs. Informal care included cost estimates regarding informal care as well as voluntary care (Table 1). Primary care was defined as health care provided by a medical professional (such as a general practitioner, physical therapist, or social worker) with whom a client has initial contact and that could refer a client to a specialist. Secondary care was defined as medical care provided by a specialist or facility upon referral by a primary care professional that requires more specialized knowledge, skills, or equipment that can be provided in primary care. Care services provided on a daily or weekly basis, for which the duration of the session varies per patient, such as nurse aide or physiotherapy, were assessed in number of times per week and amount of time per session. In addition, costs of health care programs, such as screening programs and therapies, were based on information from the Dutch Health Authority and the Foundation National Program for Flu Preventions (SNPG). In most cases, the MDS-HC solely assessed whether services were provided within a given timeframe of 7 days (yes/no) but not the frequency and duration of service use. To overcome this, several assumptions were made regarding service utilization and costs: Organisation for Economic Co-operation and Development (OECD) data from the year 2002 were used to estimate the average duration of hospital stay per country.[21] Costs of chemotherapy were based on unweighted average treatment costs of the four most prevalent types of cancer requiring chemotherapy. Prices covered chemotherapy for an average of seven administrations of chemotherapy per treatment round. For radiotherapy, prices were calculated for an average of 25 sessions. Costs of blood transfusions were based on the most frequently applied form, namely packed red blood cells. Cost estimates for dialysis were based

Table 1. Cost per unit of care delivery.

SERVICE	COST PER UNIT	FREQUENCY OF USE (18)	AVERAGE CONTRIBUTION PER CLIENT (% OF TOTAL)
Primary care			€ 3776 (10.4)
Physical therapy	€38.52 per session	Hours per week	
Occupational therapy	€23.54 per session	Hours per week	
Speech therapy	€35.31 per session	Hours per week	
Rehabilitation therapy	€37.45 per session	Received yes/no per week	
Addiction treatment	€6461.46 or €3643.05 per full or partial treatment	Received yes/no/partially per week	
Social worker	€69.56 per session	Number of visits per week	
GP visit/visit to out-patient clinic	€77.05 per visit	Number of visits per week	
Secondary care			€ 4799 (13.2)
Day care hospital	€286.60 per day	Number of visits per week	
Hospital stay overnight	€489.04 per night	Number of visits in last 90 days	
Visit emergency room	€161.59 per visit	Number of visits in last 90 days	
Emergency assistance	€37.99 per visit	Number of visits in last 90 days	
Blood transfusion	€215.09 per bag	Received yes/no per week	
Dialysis	€238.50 per total treatment	Received yes/no per week	
Chemotherapy	€9589.95 per total treatment	Received yes/no/partially per week	
Radiotherapy	€728.12 per total treatment	Received yes/no/partially per week	
Flu vaccine	€10.63 per vaccine	Yes/no in last 2 years	
Mammography	€65.72 per test	Yes/no in last 2 years	
Endoscopy screening	€366.35 per test	Yes/no in last 2 years	
Tracheostoma care	€317.34 per test	Received yes/no per week	
Oxygen	€575.73 per week	Received yes/no per week	
Ventilator	€1070.59 per machine	Received yes/no per week	
Incontinence care			
Urine/feacal care			
Catheter/stoma	€43.62 per week	Use per week (yes/no)	
Incontinence material			
Usually continent	€3.57 per week	Use per week	
Occasionally incontinent	€9.10 per week	Use per week	
Frequently incontinent	€12.60 per week	Use per week	
Always incontinent	€35.00 per week	Use per week	
Social care			€1649 (4.5)
Day center	€108.20 per week	Received yes/no in last week	
Day care	€568.00 per week	Received yes/no in last week	
Meals on wheels	€6.44 per day	Days per week	

(Continued)

Table 1. (Continued)

SERVICE	COST PER UNIT	FREQUENCY OF USE (18)	AVERAGE CONTRIBUTION PER CLIENT (% OF TOTAL)
Medical alarm	€20.06 per month	Yes/no per week	
Home care			€12 039 (33.0)
Home care	€51.69 per hour	Hours per week	
Home help	€25.68 per hour	Hours per week	
Visiting nurse	€69.56 per hour	Hours per week	
Daily nurse checks	€162.19 per week	Yes/no per week	
Non-daily nurse checks	€92.68 per week	Yes/no per week	
Informal care			€14 178 (38.9)
Informal care	€13.38 per hour	Hours per week	
Volunteer	€13.38 per hour	Hours per week	

Abbreviation: GP, general practitioner.

on long-term renal insufficiency, for which dialysis is provided at home. Costs of medical devices and materials, such as oxygen and incontinence material were based on prices from suppliers. Regarding incontinence material, total costs were estimated based on the reported severity of incontinence. All prices were indexed to the year 2013. See Table 1 for assessment units and unit costs.

To estimate societal costs per client, linear extrapolation was used. All costs per service use item for baseline and 12-month assessments were multiplied by the number of times this service was used per recall period (1 week or 3 months) and extrapolated to cover 6 months. To estimate 1-year societal costs, baseline and 12-month costs both were converted to 6-month cost estimates and were added up to cover a 12-month period.

Predictors of societal costs

Client characteristics assessed at baseline with the MDS-HC were evaluated as candidate predictors of societal costs. Candidate predictors were derived from previous prediction and costing studies among community-dwelling persons with dementia (selected patient group) and from what is generally assumed about the inter-relationship between older home care clients and societal costs.[10,12,14,22,23] These included socio-demographic characteristics, clinical conditions, and lifestyle characteristics (Table 2).

Socio-demographic characteristics, included age, sex, marital status, and country of residence. Countries were divided into three groups (low, medium, and high impairment) based on average functional dependency and cognitive impairment of clients per country at baseline.[7] Clients from Iceland, the Netherlands, Denmark, Finland, Sweden, Czech Republic, and Norway were considered to have low levels of impairment; clients from United Kingdom and Germany medium levels of impairment and clients from France and Italy were considered to have high levels of impairment.

Clinical characteristics. Need for support in ADLs was assessed with the Activities of Daily Living Hierarchy (ADLH) scale (range: 0-6). Higher scores indicate more ADL limitations.[24] Cognitive impairment was assessed using the Cognitive Performance Scale (CPS, range: 0-6). Higher scores indicate more severe cognitive impairment.[25] Depressive symptoms were assessed using the Depression Rating Scale (DRS, range: 0-14). Symptoms indicating a possible clinical depression were considered to be present if the score on the DRS was three or higher.[26] Health instability was assessed using the Changes in Health, End-Stage Disease, Signs, and Symptoms Scale (CHESS, range: 0-5). Higher scores indicate higher health instability.[27,28] Presence of swallow and/or chewing problems was used as an indication for problems with oral health. Incontinence was defined as urine and/or fecal incontinence. Other clinical characteristics that were taken into account included limitations in going out due to fear of falling; behavioral problems (including wandering, verbally or physically abusive behaviors, socially inappropriate behaviors, resisting care, or hallucinations); hip fracture during the last 90 days; presence of pressure ulcers, morbid obesity, body mass index (BMI) >40, number of different medications used; and the presence of various neurological diseases, heart and vascular disorders, locomotor disorders, and other long-term conditions.

Lifestyle characteristics. This included smoking on a daily basis and alcohol abuse. Alcohol abuse was defined as client had to have a drink first thing in the morning to steady nerves or has been in trouble because of drinking.

Table 2. Baseline characteristics of the study population.

	TOTAL	CZECH REPUBLIC	DENMARK	FINLAND	FRANCE	GERMANY	ICELAND	ITALY	NETHERLANDS	NORWAY	SWEDEN	UNITED KINGDOM
	(N = 1970)	(N = 196)	(N = 208)	(N = 128)	(N = 256)	(N = 355)	(N = 233)	(N = 58)	(N = 100)	(N = 220)	(N = 46)	(N = 170)
Socio-demographics												
Age, mean (SD), years	81.7 (7.3)	81.3 (6.5)	84 (7.0)	81.2 (7.4)	82 (7.8)	80.4 (7.9)	81.5 (6.5)	79 (8.0)	80.1 (6.8)	83.3 (6.5)	84.2 (5.9)	81.3 (7.2)
Female, %	77	83	80	84	76	74	76	69	76	73	76	74
Married, %	22	14	15	10	38	25	23	40	21	19	9	19
Clinical conditions												
ADL needs (ADLH), mean (SD)	0.9 (1.6)	0.4 (1.1)	0.1 (0.6)	0.3 (1.0)	2.6 (2)	1.6 (1.8)	0.2 (0.7)	2.5 (2.1)	0.3 (0.9)	0.4 (1)	0.1 (0.4)	0.9 (1.5)
IADL, mean (SD)	8.9 (6.1)	8.5 (4.7)	4.9 (5.1)	6.7 (4.5)	14.1 (5.6)	10.6 (6.4)	6.8 (5.3)	13.5 (5)	6.6 (5)	6.2 (4.8)	2.5 (2)	12 (5.1)
CHESS, mean (SD)	2.3 (0.8)	2.7 (0.9)	2.3 (0.7)	2.4 (0.7)	2 (0.8)	2.2 (0.8)	2.4 (0.7)	1.9 (0.7)	2.7 (0.8)	2.3 (0.7)	2.2 (0.8)	2.6 (1)
Cognitive impairment (CPS > 2), %	24	25	12	20	42	35	10	36	26	13	7	24
Depressive symptoms (DRS ⩾ 3), %	14	26	6	6	20	14	8	38	18	5	2	22
Limitations going out, %	46	60	31	41	74	40	41	47	39	41	30	46
Behavioral problems, %	4	5	1	0	11	7	1	9	2	1	0	5
Morbid obesity, %	6	0	5	9	6	5	2	2	8	1	0	2
Oral conditions, %	19	44	13	21	26	15	15	22	15	5	15	15
Incontinence, %	29	24	25	26	46	29	24	41	24	24	28	29
Hip fractures, %	7	15	5	7	7	4	7	10	4	10	9	6
Pressure ulcer, %	5	5	0	1	11	7	2	14	2	1	0	5

(Continued)

Table 2. (Continued)

	TOTAL	CZECH REPUBLIC	DENMARK	FINLAND	FRANCE	GERMANY	ICELAND	ITALY	NETHERLANDS	NORWAY	SWEDEN	UNITED KINGDOM
	(N = 1970)	(N = 196)	(N = 208)	(N = 128)	(N = 256)	(N = 355)	(N = 233)	(N = 58)	(N = 100)	(N = 220)	(N = 46)	(N = 170)
Number of medication intake, mean (SD)	5.4 (2.8)	6.5 (2.5)	5.2 (2.6)	7 (2.3)	6.1 (2.6)	4.7 (3.1)	5.8 (2.6)	4.6 (2.5)	4.7 (2.7)	4.4 (2.7)	5.2 (3)	5.5 (2.6)
Diabetes, %	18	26	8	34	14	32	10	16	21	5	2	14
Arthritis, %	27	58	26	32	16	8	41	12	24	11	17	60
Cancer, %	6	10	3	10	4	5	6	5	10	7	0	8
High blood pressure, %	34	46	19	55	24	38	51	33	25	17	9	43
Cerebro vascular accident, %	17	17	12	13	21	21	3	33	9	16	26	26
Coronary artery disease, %	19	54	4	34	12	13	17	16	11	16	9	29
Dementia, %	8	6	1	4	8	17	9	7	2	9	2	6
Hemiplegia, %	7	7	3	9	11	0	6	9	2	10	0	16
Multiple sclerosis, %	1	1	0	1	2	1	1	0	0	2	0	1
Parkinson, %	5	7	0	4	9	7	3	5	4	2	0	5
Osteoporosis, %	16	27	10	17	8	17	15	14	18	12	37	15
Lifestyle characteristics												
Alcohol abuse, %	1	2	0	2	2	2	1	0	0	1	2	1
Daily tobacco use, %	12	10	20	12	4	6	19	0	22	15	11	14

Abbreviations: ADL, activities of daily living; ADLH, Activities of Daily Living Hierarchy Scale; CHESS, Changes in Health, End-Stage Disease, Signs, and Symptoms Scale; CPS, Cognitive Performance Scale; DRS, Depression Rating Scale; IADLH, Instrumental ADL Hierarchy Scale; SD, standard deviation.

Statistical analyses

Client characteristics at baseline and the distribution of care costs were described using descriptive statistics and frequencies. To explore country differences between client characteristics (socio-demographic, clinical, and lifestyle characteristics), one-way analyses of variance (ANOVAs), and chi-square tests were performed.

Missing data for care utilization were handled using multiple imputation with fully conditional specification and predictive mean matching. In fully conditional specification, an imputation model for each variable with missing values is specified iteratively. In each iteration, it sequentially imputes missing values starting from the first incomplete variable.[29] Predictive mean matching was used to account for the skewed distribution of costs.[30] It imputes a value randomly from a set of observed values whose predicted values are closest to the predicted value for the missing value from the simulated regression model.[31,32] The constructed imputation model was based on variables significantly associated ($P < 0.05$) with the outcome variable and with missings. The number of imputed data sets was increased until the loss of efficiency was smaller than 5%.[30] A total of 10 data sets were created, after which each data set was analyzed separately. Using Rubin's rules, the parameter estimates were pooled by taking the average over the parameter estimates from all 10 imputed data sets. The standard errors were pooled by combining the within imputation variance and the between imputation variance.[33]

To identify predictors of societal costs, a generalized linear model (GLM) was used, employing a gamma distribution with a log link using societal costs as the independent variable. Generalized linear model was chosen, as it performs well for bias and precision with skewed cost data.[34] Pearson correlation coefficients were calculated to investigate collinearity between all potential predictor variables. In case correlations between variables exceeded r = 0.4, only the variable with the strongest association with the outcome was retained in the analysis. Subsequently, we first performed univariate GLM analyses to pre-select important predictors of societal costs, using a cut-off value of $P \leqslant 0.2$. This cut-off value was used to eliminate the possibility that important predictors were excluded from the final prediction model in this first phase of the analyses. Second, we performed a multivariate GLM analysis with a backward selection of all variables selected from the univariate analyses.[35] The final prediction model included variables that predicted estimated societal costs with *P*-values ⩽0.05. Regression coefficients are presented with 95% confidence intervals. *R2* statistics (explained variance) are not reported for GLM models with a gamma distribution and thus not included. All analyses were performed in SPSS 20.0 and STATA 12.0.

Sensitivity analysis. To evaluate whether the results of this study were influenced by imputation of costs data, a sensitivity analysis with complete cases was performed. Furthermore, to provide a comprehensive view of factors related to formal resource utilization, a sensitivity analysis from a health care perspective was performed. Costs of primary, secondary, social, and home care were included in this analysis.

Results

Study sample

The total AdHoc sample consisted of 4007 participants, of which 2037 (51%) participants were excluded for this study. Exclusion criteria were loss for follow-up without reason (n = 1568), hospitalization in an acute ward (n = 352), discharged from service (n = 37), nursing home admission (n = 34), death (n = 26), no care utilization during an assessment (n = 18), or age <65 years (n = 2).

The study sample in these analyses consisted of 1970 participants. The average age of the participants was 81.7 (SD: 7.3) years, and 77% were women (Table 2). Mean ADLH score was 0.9 (SD: 1.6), indicating limited dependency with daily activities. One quarter of the study sample experienced cognitive impairment and 29% suffered from incontinence. Almost half of the study sample (46%) experienced limitations going out because of a fear of falling. Other frequently reported health indicators were high blood pressure (34%), arthritis (27%), coronary artery disease (19%), and diabetes (18%). No collinearity between potential predictor variables was observed.

Statistically significant differences ($P < 0.05$) between countries were found for all characteristics, except sex, alcohol abuse, and multiple sclerosis. Compared with participants in the other countries, participants in France and Italy were more often married (39% on average versus 9% to 25%), had the highest ADL and Instrumental Activities of Daily Living Hierarchy Scale (IADL) scores, and were more often incontinent (44% on average vs 24%-29%). Furthermore, together with German participants, they were most often impaired in cognition (39% on average vs 7%-26%) and experienced most often behavioral problems (9% on average vs 0%-5%). A high proportion of Czech participants had oral conditions (44% vs 5%-26%) and coronary artery disease (CAD; 54% vs 4%-34%). In addition, health instability was significantly higher in Czech Republic than in other countries except in The Netherlands and United Kingdom. Limitations in going out because a fear of falling was most often experienced by French participants (74%), followed by Czech participants (60%). Finally, participants in Finland used more medications compared with participants in other countries.

Compared with the study sample, participants lost for follow-up were significantly more often men; married and older; experienced more often limitations with ADL and IADL; cognitive impairment and depressive symptoms; and had more often behavioral problems, oral conditions, pressure ulcers, cancer, and/or dementia. Finally, participants lost for follow-up suffered less often from incontinence and experienced less health instability than responders.

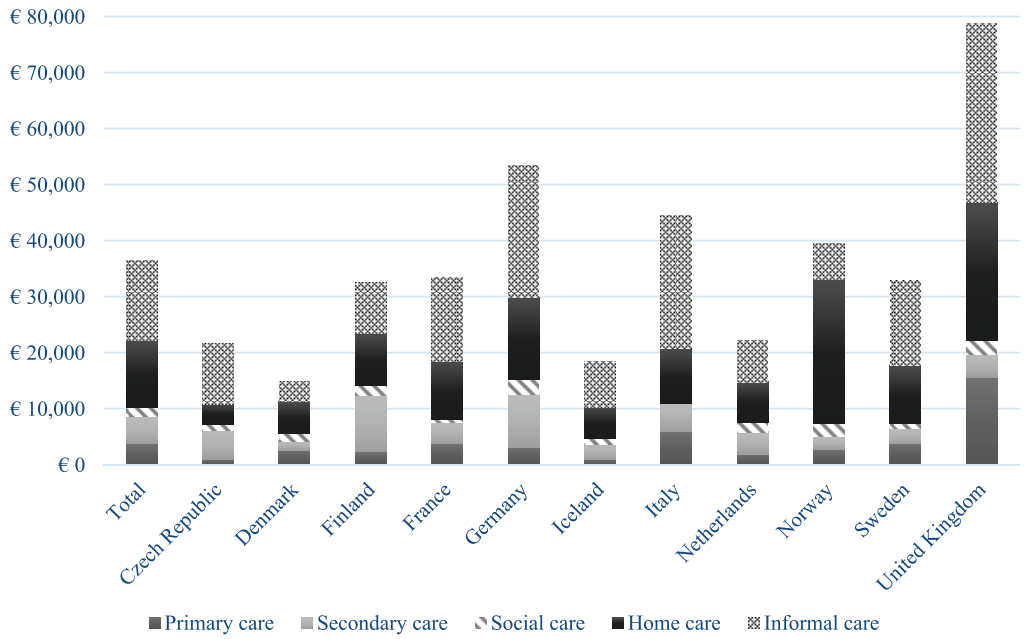

Figure 1. Annual societal costs estimates and distribution of costs categories by county.

Societal Costs

Societal costs per participant receiving home care for 12 months were on average €36 442 (Figure 1). The highest societal costs were found for the United Kingdom (€78 836 per participant per year), and the lowest societal costs were found for Denmark (€14 865 per participant per year).

The share of informal care costs to societal costs in the total sample was 39% and ranged from 16% in Norway to 53% in Italy (Figure 1). Within formal health care costs, home care costs (eg home help and home nursing) were the largest contributor (33% of societal costs), followed by secondary care costs (13%). Social care and primary care costs were the smallest contributors (5% and 10% of societal costs, respectively).

The high societal costs in the United Kingdom were largely a result of many respondents reporting a large number of informal care hours; around one quarter (n = 42) received 24 hours per day over the last 7 days before assessment. Total costs of informal care in the other countries were 26% (Italy, €23 759) to 89% (Denmark, €3,576) lower than in the United Kingdom. Also, primary care costs calculated for United Kingdom were relatively high, as compared with the other countries.

Predictors of Societal Costs

Univariate analyses

Table 3 summarizes the results of the univariate analysis of all potential predictors for societal costs among older adults that received home care during the course of 1 year. Of the sociodemographic characteristics, country of residence, female sex, and being married were found to be potential predictors of annual societal costs. Of the clinical and lifestyle characteristics, ADL dependency, cognitive impairment, presence of depressive symptoms, health instability, limitations of going out because of fear of falling, behavioral problems, morbid obesity, oral conditions, incontinence, presence of pressure ulcers, number of medication intake, diabetes, arthritis, cerebro vascular accident (CVA), dementia, hemiplegia, Parkinson' disease, and smoking on daily basis were found to be potential predictors of societal costs (Table 3).

Multivariate analyses

The final multivariate analysis indicated that country of residence, being married, ADL dependency, cognitive impairment, limitations of going out because of fear of falling, oral conditions, number of medication intake, arthritis, and CVA statistically significantly contributed to societal costs (Table 3).

Sensitivity analysis

A sensitivity analysis was performed using complete cases only (n = 1348). A similar combination of predictors was found in this subsample, indicating that the effect of the imputation strategy was limited.

A secondary sensitivity analysis from health care perspective indicated that country of residence, ADL and IADL dependency, and arthritis statistically contributed to health care costs (Table 4).

Discussion

This study shows that societal costs of older adults receiving home care from urban areas in 11 European countries varied to a large extent. In most countries, informal care was the most important cost driver for societal costs, except for Norway and Denmark, where the largest part could be attributed to home care.

Table 3. Results of the univariate and multivariate analyses.

PREDICTOR	UNIVARIATE ANALYSES		MULTIVARIATE ANALYSIS	
	β (95% CI)	*P*-VALUE	β (95% CI)	*P*-VALUE
Socio-demographics				
Country dummy 1	10582 (5876; 15287)	<.001	878 (–3208; 4963)	0.669
Country dummy 2	36745 (30764; 42727)	<.001	24210 (19303; 29117)	<.001
Age	–198 (–510; 115)	.22		
Female sex	–16158 (–23205; –9111)	<.001		
Being married	34269 (24849; 43690)	<.001	9998 (5976; 14020)	<.001
Clinical conditions				
ADL needs (ADLH)	17173 (13971; 20375)	<.001	5238 (3704; 6772)	<.001
IADL needs (IADLH)				
CHESS	–4667 (–7136; –2197)	<.001		
Cognitive impairment (CPS)	34195 (25884; 42505)	<.001	2056 (681; 3430)	<.01
Depressive symptoms (DRS ⩾ 3)	13914 (4957; 22870)	<.001		
Limitations going out because of fear of falling	6384 (1117; 11652)	.02	3536 (1106; 5967)	<.00
Behavioral problems	28383 (13541; 43226)	<.001		
Morbid obesity	–6281 (–15534; 2972)	.18		
Oral conditions	5143 (–1552; 11838)	.13		
Incontinence	20308 (13663; 26954)	<.001		
Hip fractures	–593 (–10040; 8854)	.90		
Pressure ulcer	53461 (25281; 81640)	.00		
Number of medication intake	293 (–557; 1143)	.50	518 (2; 1035)	.05
Diabetes	7743 (828; 14658)	.03		
Arthritis	–5809 (–10739; –879)	.02	–3925 (–6597; –1252)	<.01
Cancer	–4369 (–13034; 4296)	.32		
High blood pressure	287 (–4735; 5309)	.91		
Cerebro vascular accident	30345 (20154; 40536)	<.001	7506 (2870; 12142)	<.01
Coronary artery disease	883 (–5183; 6950)	.78		
Dementia	28894 (14008; 43780)	<.001		
Hemiplegia	29382 (11707; 47058)	<.001		
Multiple sclerosis	32721 (–21501; 86942)	.24		
Parkinson disease	14842 (–1223; 30907)	.07		
Osteoporosis	–3374 (–9512; 2765)	.28		
Lifestyle characteristics				
Alcohol abuse	–8654 (–21627; 4318)	.191		
Daily tobacco use	–7990 (–12844; –3138)	<.01		
Intercept			16465 (10865; 22064)	<.001

Abbreviations: ADL: activities of daily living; ADLH, Activities of Daily Living Hierarchy Scale; CHESS, Changes in Health, End-Stage Disease, Signs, and Symptoms Scale; CPS, Cognitive Performance Scale; DRS, Depression Rating Scale; IADLH, Instrumental ADL Hierarchy Scale.
Country dummy 1: medium impairment versus low impairment. Country dummy 2: high impairment versus low impairment.

Table 4. Results of the sensitivity analysis.

PREDICTOR	UNIVARIATE ANALYSES		MULTIVARIATE ANALYSIS	
	β (95% CI)	*P*-VALUE	β (95% CI)	*P*-VALUE
Socio-demographics				
Country dummy 1	1659 (–1821; 5139)	.34	–4354 (–7522; –1186)	.009
Country dummy 2	18 113 (13 795; 22 432)	<.001	12 945 (9092; 16 799)	<.001
Age	58 (–94; 209)	.45		
Female sex	–3442 (–6462; –423)	.03		
Being married	1574 (6374; 0)	.04		
Clinical conditions				
ADL needs (ADLH)	3981 (3019; 4943)	<.001	1832 (900; 2764)	<.001
IADL needs (IADLH)	1110 (891; 1329)	<.001	587 (385; 789)	<.001
CHESS	–1413 (–2660; –165)	.03		
Cognitive impairment (CPS)	3143 (2189; 4097)	<.001		
Depressive symptoms (DRS ⩾ 3)	2271 (–1368; 5911)	.22		
Limitations going out because of fear of falling	540 (–1818; 2897)	.65		
Behavioral problems	4046 (19 271; 0)	.01		
Morbid obesity	–3311 (–8306; 1684)	.19		
Oral conditions	1627 (3523; 0)	.84		
Incontinence	1353 (7897; 0)	<.001		
Hip fractures	–979 (–5151; 3192)	.65		
Pressure ulcer	14 493 (9193; 19 792)	<.001		
Number of medication intake	57 (–434; 547)	.23		
Diabetes	1529 (–1678; 4736)	.35		
Arthritis	–2188 (–4874; 497)	.11	–3575 (–6128; –1021)	<.01
Cancer	314 (–4646; 5274)	.90		
High blood pressure	–1164 (–3639; 1310)	.36		
Cerebro vascular accident	8883 (5061; 12 704)	<.001		
Coronary artery disease	–460 (–3301; 2380)	.75		
Dementia	6632 (1561; 11 704)	.01		
Hemiplegia	9877 (2762; 16 991)	.01		
Multiple sclerosis	15 798 (–3913; 35 508)	.12		
Parkinson disease	3572 (–2563; 9707)	.25		
Osteoporosis	1577 (2451; 0)	.68		
Lifestyle characteristics				
Alcohol abuse	–1663 (–11 613; 8288)	.74		
Daily tobacco use	–1981 (–5545; 1583)	.28		
Intercept			13 472 (9890; 17 053)	<.001

Abbreviations: ADL, activities of daily living; ADLH, Activities of Daily Living Hierarchy Scale; CHESS, Changes in Health, End-Stage Disease, Signs, and Symptoms Scale; CPS, Cognitive Performance Scale; DRS, Depression Rating Scale; IADLH, Instrumental ADL Hierarchy Scale.
Country dummy 1: medium impairment versus low impairment. Country dummy 2: high impairment versus low impairment.

The potential predictors considered to be related to societal costs in this study differed somewhat from the criteria for the classification of home care clients into the Resource Utilization Groups III/Home Care (RUGII/HC) case-mix system.[23,36] The RUGIII/HC was developed based on clinical patient characteristics and explains the utilization of home health aides, visiting nurses, home making services, social worker, physical therapy, occupational therapy, speech therapy, and informal care.[23] This study takes a broader range of services and treatments into account; therefore, potential predictors were identified from studies with comparable cost perspectives. Similar to our findings, ADL and cognitive impairment are also associated with higher-care intensity in the RUGIII/HC case-mix system.[23,36] ADL dependency and cognitive impairment were also associated with higher societal costs in other studies.[10,11,12,13,14,22] However, these previous studies focused on community-dwelling older adults with dementia only. Our study adds to these findings by confirming that these determinants are also predictive of societal costs in a large sample of home care clients. Furthermore, CVA and arthritis belong to the group of major and long-term diseases. The role of home helpers or home nurses has become increasingly important as patients with these long-term conditions are discharged from hospitals and rehabilitation centers early in the course of illness and require more sophisticated nursing management at home. This might explain the high associated costs. Furthermore, limitations of going out were associated to societal costs and could be targeted in interventions. Interventions could, for example, focus on improving functional ability or reduce fall risk induced by drug use because it is assumed that these are contributory factors to falls.[37] Regarding the socio-demographic determinants considered, being married was associated with significantly higher societal costs. Older adults, who are living with their spouse, are likely to receive more informal care on average, than older adults who are not married, which is in line with previous research.[38] Unmarried older adults are in turn likely to receive more formal home care services than people who are married.

The provision of services differed among the home care organizations that were involved in the AdHoc study. Some of these organizations provided extensive formal social care (this included organizations from urban areas in Norway, Sweden, Finland, Denmark, and the Netherlands), others provided predominantly health care and little or no social care (Italy, Iceland, and the United Kingdom) or a mix of health care and social care (Germany).[39] Home care organizations in France and Denmark had few provisions.[39] It is likely that patterns of formal and informal care use are related to the provision of services. For example, in our sample, the share of informal care costs to societal costs was lower for clients from countries with extensive formal social care provision, than for clients from organizations with limited social care provision. However, our focus in this study was the relation between client characteristics and 1-year societal costs. Therefore, these differences in structure of health and social care system were not taken into account in the analyses.

Strengths and limitations

To the best of our knowledge, this is one of the first studies that investigated such a broad set of potential predictors of societal costs in a sample of community-living older home care clients in 11 European countries. Predictors that were assessed included a wide-range of socio-demographic characteristics, clinical and lifestyle determinants, and the presence of several clinical conditions. Another strength is that costs of resource utilization were estimated based on MDS-HC records. The updated version of the MDS-HC, the interRAI-HC, was found to be suitable to estimate societal cost of resource utilization in community-dwelling older adults.[40] This instrument is part of a suite of instruments that are globally used in routine care to support assessment and care planning in health care settings for vulnerable patient groups. An advantage of using a routine care instrument for costs estimates is that the information is readily available and additional patient burden for the purpose of cost of care assessments can be avoided. Future studies could use this valuable source of information.

Furthermore, costs were estimated from a societal perspective, including costs of health care utilization (primary, secondary, home care, and social care) and informal care, thereby providing a comprehensive view of the total costs of care utilization, since, as the results support, a substantial amount of care in the community is being provided by informal carers. In addition, a broad range of incidentally occurring services were taken into account in this study, as well as less frequently provided services, such as chemotherapy, were considered, resulting a detailed and complete estimate of societal costs. Finally, a sensitivity analysis was performed from a health care perspective to provide additional information for policy makers from countries where decision-making is based on the health care perspective.

A potential limitation is that resource utilization was valued using Dutch standard costs according to the Dutch guidelines for costing studies for all counties under study. For some services and treatments, standard costs were not available, Dutch tariffs or market prices were then used. The advantage of this approach for our study, rather than using country-specific prices is that variations in costs estimates due to country-specific differences in care valuations are avoided. It enables a relative benchmark of care utilization across countries, overcoming differences caused by factors related to national contexts rather than care utilization, such as wages. By choosing this approach cost estimates of the various countries do not reflect the "actual" care costs per country. However, since our overall aim was to identify universal predictors for a cross-European population, we think that the advantage of this approach outweighs the disadvantage of this approach.

Another limitation that needs to be considered is that the samples were drawn from urban centers in the participating countries, and, therefore, cannot be regarded as national representative samples.[7] An additional limitation is the fact that data were collected during 2001 and 2002. However, we think that the results give a good overview of the distribution of categories within societal costs and client characteristics associated with these societal costs across 11 European countries. Future studies should confirm whether these predictors have changed over the years. Furthermore, we had to exclude 50% of the clients due to discharge and loss to follow-up. As participants lost for follow-up experienced more limitations on average compared with the responders, this might have led to an underestimation of societal costs. To calculate societal costs over a 12-month period, we extrapolated costs at baseline and at 12 months to a period of 6 months. We assumed cost development between the two assessments to be linear. This may have led to either over or underestimation of costs on the individual level. However, on the group level, we expect that the impact is limited. Some of the recall periods used in the MDS 2.0, such as physician visits or outpatient hospital visits over a 7-day period, lead to certain bias in the approach we used. In the interRAI-HC,[39,41] the revised version of the MDS 2.0, these recall periods have been altered to a more convenient 90-day period. A paper validating cost of societal care estimates with the interRAI-HC showed that this approach is valid over a 3-month recall period.[40] To obtain more sensitive costs of care estimates, we advocate using data that are more frequently collected, at least once per 6 months.

Several assumptions had to be made, since for some of the services, only information on whether the service was received in a certain period was available and not the actual amount and duration of the service. For instance, national averages of hospitalization days according to the OECD were used to calculate the total number of days a participant was admitted to a hospital.[21] This might have resulted in less accurate but comparable estimates across countries.

Conclusions

In this study, we showed that societal costs of older home care clients were substantial and varied to a large extent between countries. Country of residence, marital status, ADL dependency, cognitive impairment, limitations of going out because of fear of falling, number of medication intake, oral conditions, arthritis, and CVA were significantly associated with societal costs. Of these characteristics, ADL dependency and limitations of going out because of fear of falling may be modifiable creating opportunities to curtail societal costs. Thus, decision-makers may consider targeting these factors with specific interventions with the aim of reducing societal costs of home care clients in Europe.

Author note

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Author Contributions

LIVL, BSHO, HPJVH, and JEB conceived and designed the paper. LIVL, BSHO, and JEB analyzed the data. BSHO wrote the first draft of the manuscript. LIVL, BSHO, HGVDR, HPJVH, and JEB contributed to the writing of the manuscript. All authors agree with manuscript results and conclusions, jointly developed the structure and arguments for the paper, made critical revisions and approved the final version.

Disclosures and Ethics

As a requirement of publication, the author(s) have provided to the publisher signed confirmation of compliance with legal and ethical obligations including but not limited to the following: authorship and contributorship, conflicts of interest, privacy, and confidentiality and (where applicable) protection of human and animal research subjects. The authors have read and confirmed their agreement with the ICMJE authorship and conflict of interest criteria. The authors have also confirmed that this article is unique and not under consideration or published in any other publication and that they have permission from rights holders to reproduce any copyrighted material. Any disclosures are made in this section. The external blind peer reviewers report no conflicts of interest.

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